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EXAMINER	
TALMAN, JAMES R	

ART UNIT	PAPER NUMBER
3737	

NOTIFICATION DATE	DELIVERY MODE
09/13/2007	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)
	10/711,892	BRAU ET AL.
	Examiner	Art Unit
	James R. Talman	3737

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 8/15/2007.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-28 and 30-33 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-28 and 30-33 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

1. Receipt of amendment dated 8/16/2007 is acknowledged. Claim 29 is cancelled. Claims 1-28 and 30-33 are pending.

Response to Arguments

2. Applicant's arguments filed 8/16/2007 have been fully considered but they are only partially persuasive.

3. On page 8 of Applicant's remarks, it is argued that Larson does not disclose determining motion from non-spatially encoded data.

4. The Examiner respectfully disagrees with this argument. Larson discloses synchronizing the MR imaging data with the motion using timing information (paragraph 19) that detects the presence of motion. Larson also discloses that the timing information may be extracted from non-imaging data (paragraph 20), which is equivalent to non-spatially encoded data, because spatial encoding is inherently necessary in MRI in order to form the image.

5. On page 8 of Applicant's remarks, it is argued that Larson does not disclose passing through the origin of k-space at least once every repetition interval.

6. The Examiner respectfully disagrees with this argument. Larson discloses passing the origin of k-space "relatively frequently so that extracted timing information provides temporal resolution that is high enough to represent the body motion of interest," clearly anticipating the need to pass through the origin of k-space multiple

times in every repetition interval if necessary to capture rapid motion occurring on a time scale much shorter than the repetition interval.

7. On page 8 of Applicant's remarks, it is argued that Larson does not disclose sampling the MR signal before the onset of spatial encoding gradient.

8. The Examiner respectfully disagrees with this argument. Larson discloses that the timing information may be extracted from non-imaging data (paragraph 20), which is equivalent to non-spatially encoded data, because spatial encoding is inherently necessary in MRI in order to form the image. Therefore, Larson discloses sampling the MR signal at any time when the spatial encoding gradients are not present.

9. On page 9 of Applicant's remarks it is argued that a distinction should be drawn between tracking and timing.

10. The Examiner agrees that tracking and timing are different in general, but as disclosed in Larson they are equivalent concepts (The extracted timing information may be processed to provide temporal correspondence with the motion, paragraph 18).

11. On page 9 of Applicant's remarks it is argued that acquiring data at the origin of k-space is not by definition performed with spatial encoding gradients set to zero.

12. The Examiner stands corrected. As argued by the applicant, it is possible to acquire data at the origin of k-space without the spatial encoding gradients being set to zero. However, Larson discloses that the timing information may be extracted from non-imaging data (paragraph 20), which is equivalent to non-spatially encoded data, because spatial encoding is inherently necessary in MRI in order to form the image. Furthermore, it is the Examiner's position that following the RF pulse, and before the

spatial-encoding gradients are applied, the signal is at the center of k-space by definition.

13. On page 11 of Applicant's remarks, it is argued that Larson does not disclose sampling the MR signal after the rewinder gradient.

14. The Examiner respectfully disagrees with this argument. Larson discloses that the timing information may be extracted from non-imaging data (paragraph 20), which is equivalent to non-spatially encoded data, because spatial encoding is inherently necessary in MRI in order to form the image. Therefore, Larson discloses sampling the MR signal to determine motion at any time when the rewinder gradient is not present.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1-9, and 12-26 are rejected under 35 U.S.C. 102(e) as being anticipated by Larson et al (US patent application publication 2004/0155653).

As per claim 1, Larson et al discloses an MRI apparatus as claimed, comprising determining motion in the region of interest (Synchronizing MR images to the motion of a patient, see abstract), using any k-space trajectory (for example radial, spiral, or

Cartesian, paragraph 37) that pass through the origin of k-space (This is preferably done by acquiring data along k-space trajectories that frequently pass through the center (or origin) of k-space, paragraph 36), and using non-imaging, non-spatially-encoded data (The timing information does not need to be extracted exclusively from imaging data, Paragraph 60). Further, Larson et al implies the possibility of acquiring data at least once every repetition interval of a pulse sequence if necessary (It is not necessary that every data acquisition trajectory pass through the k-space origin, but it is preferred that this happen relatively frequently... so that extracted timing information provides temporal resolution that is high enough to represent the body motion of interest, paragraph 38). Further, Larson et al implies a plurality of gradient coils, an RF transceiver system, an RF switch, and an RF coil assembly, and a computer to process the data (processed timing data, paragraph 18), because these components are all necessary to generate an MR image.

As per claim 2, Larson et al further discloses using magnitude or phase information to determine motion (e.g. magnitude, phase, rate of change – may be useful for synchronizing the associated imaging data, paragraph 45).

As per claims 3 and 4, Larson et al further discloses using the motion information for retrospective or prospective gating (synchronize, paragraph 18), and respiratory-gated acquisition (Respiratory motion information can be extracted directly from the MR data and used to synchronize the image data with the quiescent period of the respiratory cycle, avoiding motion artifacts, paragraph 14).

As per claim 5, Larson et al further discloses using the motion information to adjust scan timing, e.g. slice timing, (provide temporal correspondence with the motion, paragraph 18).

As per claim 6, Larson et al further discloses retrospective correction of phase errors (synchronization of the data can be done retrospectively, paragraph 50).

As per claim 7, Larson et al further discloses using a plurality of k-space points (k-space points at or near the origin, paragraph 17).

As per claim 8, Larson et al discloses determining fluctuations (various characteristics of the signal – e.g. rate of change, paragraph 45). The signal is inherently dependent on transverse magnetization, as all MR signals are determined by the transverse component of the spin magnetization.

As per claim 9, Larson et al further discloses an assembly with a plurality of RF coils (a surface array, paragraph 53), and combination of the information from the multiple coils (combination of the information, paragraph 54).

As per claim 12, MRI apparatus having a bore must inherently have a table to move the patient fore and aft within the bore because the space, typically 1m diameter, is too cramped for a patient to physically maneuver himself or herself in and out of the bore. MR systems not having a bore, for example open MR systems, would not require a patient table.

As per claim 13, Larson et al further discloses accepting/rejecting data based on the determined motion (selection done automatically based on the amplitude of the signal variation due to motion, paragraph 54).

As per claim 14, Larson et al discloses acquiring MR data during non-breathold intervals (free breathing, paragraph 14).

As per claim 15, Larson et al discloses a method of MR imaging comprising sampling MR data over a plurality of repetition time intervals for a central region of k-space prior to application of spatially encoding gradients in each repetition time interval, the k-space filled using a given k-space filling trajectory with MR data acquired (It is not necessary that every data acquisition trajectory pass through the k-space origin, but it is preferred that this happen relatively frequently ... so that extracted timing information provides temporal resolution that is high enough to represent the body motion of interest, paragraph 38), and determining motion in the region of interest (Synchronizing MR images to the motion of a patient, see abstract), using any k-space trajectory (for example radial, spiral, or Cartesian, paragraph 37) that passes through the origin of k-space (This is preferably done by acquiring data along k-space trajectories that frequently pass through the center (or origin) of k-space, paragraph 36).

As per claim 16, Larson et al further discloses acquiring MR data from a plurality of RF coils (a surface array, paragraph 53), and combining the signals from the multiple coils (combination of the information, paragraph 54).

As per claim 17, Larson et al further discloses determing which RF coil is most sensitive to motion (Thus, it may be advantageous to select only one of the imaging coils (with the selection done automatically based on the amplitude of the signal variation due to motion), paragraph 54).

As per claim 18, Larson et al further discloses using magnitude or phase information to determine motion (e.g. magnitude, phase, rate of change – may be useful for synchronizing the associated imaging data, paragraph 45).

As per claim 19, Larson et al further discloses multi-shot acquisition, i.e. one having multiple k-space trajectories (every data acquisition trajectory pass through the k-space origin, but it is preferred that this happen relatively frequently....., paragraph 38).

As per claims 20 and 21, Larson et al further discloses using the motion information for retrospective or prospective gating (synchronize, paragraph 18), and respiratory-gated acquisition (Respiratory motion information can be extracted directly from the MR data and used to synchronize the image data with the quiescent period of the respiratory cycle, avoiding motion artifacts, paragraph 14). Larson et al further discloses retrospective-gating to correct for cardiac-induced motion (Figure 6).

As per claim 22, Larson et al further discloses retrospective correction of phase errors (synchronization of the data can be done retrospectively, paragraph 50).

As per claim 23, Larson et al discloses sampling of MR data for the central region of k-space (origin) and, further implies the possibility of acquiring data at least once every repetition interval of a pulse sequence if necessary (It is not necessary that every data acquisition trajectory pass through the k-space origin, but it is preferred that this happen relatively frequently....., paragraph 38).

As per claim 24, Larson et al discloses acquiring MR data during non-breathold intervals (free breathing, paragraph 14).

As per claims 25 and 26, Larson et al discloses determining motion in the region of interest (Synchronizing MR images to the motion of a patient, see abstract), using any k-space trajectory (for example radial, spiral, or Cartesian, paragraph 37) that passes through the origin of k-space (This is preferably done by acquiring data along k-space trajectories that frequently pass through the center (or origin) of k-space, paragraph 36). Thus, the method of Larson et al does not require a separate acquisition of physiological motion data, and is independent of motion type.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claim 27 is rejected under 35 U.S.C. 103(a) as being unpatentable over Larson et al (US patent application publication 2004/0155653).

As per claim 27, Larson et al discloses using a plurality of k-space points centered about the origin (k-space points at or near the origin, paragraph 17). Larson et al as applied to claim 15 above discloses all the remaining elements of the claimed invention except that it does not explicitly disclose sampling the origin of k-space twice during each repetition interval.

Larson et al implies the possibility of acquiring data multiple times during each repetition interval of a pulse sequence if necessary (It is not necessary that every data

acquisition trajectory pass through the k-space origin, but it is preferred that this happen relatively frequently....., paragraph 38). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify Larson et al to acquire k-space origin data multiple times during each repetition interval if necessary to compensate for motion that was changing significantly during a single repetition interval.

5. Claims 10, 11, and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Larson et al (US patent application publication 2004/0155653) in view of Haacke et al (Haacke et al, Magnetic Resonance Imaging, John Wiley and Sons, 1999).

As per claims 10 and 11, Larson et al discloses retrospective correction of imaging data (synchronization of the data can be done retrospectively, paragraph 50). Further, Larson et al as applied to claim 2 above disclose all the remaining elements of the claimed invention except that it does not explicitly disclose sampling the origin of k-space twice during each repetition interval and it does not disclose the use of rewinder gradient pulses.

Larson et al implies the possibility of acquiring data multiple times during each repetition interval of a pulse sequence if necessary (It is not necessary that every data acquisition trajectory pass through the k-space origin, but it is preferred that this happen relatively frequently....., paragraph 38). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify Larson et al to acquire k-space origin data multiple times during each repetition interval if necessary to

compensate for rapid motion that was changing significantly during a single repetition interval.

Haacke et al disclose the use of rewinder gradient pulses (rewound gradients, p. 796). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify Larson et al to use rewinder gradients as taught by Haacke et al in order to accomplish first-order motion compensation, as is well known in the art.

As per claim 33, Larson et al discloses a method of MR imaging comprising the steps of acquiring first and second sets of non-spatially encoded MR data (non-imaging data, paragraph 20; it is preferred that this happen relatively frequently... so that extracted timing information provides temporal resolution that is high enough to represent the body motion of interest, paragraph 38) from a region-of-interest and determining motion in the region-of-interest from the first and the second sets of non-spatially encoded MR data (extracted timing information provides temporal resolution that is high enough to represent the body motion of interest, paragraph 38; non-imaging data, paragraph 20; Respiratory motion information, paragraph 14); Larson et al does not disclose the use of rewinder gradients and does not disclose when during the repetition interval that k-space origin data are acquired relative to the rewinder gradient.

Haacke et al discloses the use of rewinder gradient pulses (rewound gradients, p. 796). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify Larson et al to use rewinder gradients as taught by Haacke et al in order to accomplish first-order motion compensation, as is well known in the art.

The relative timing during the repetition time interval when k-space origin data are acquired (whether before or after rewinder gradients are applied) has little bearing on its motion compensation purpose and, absent any unexpected results, is considered an obvious design choice. It would have been obvious to one of ordinary skill in the art at the time of the invention to vary the time when k-space data are acquired relative to the rewinder gradient because it has been held that rearranging parts of an invention involves only routine skill in the art. *In re Japikse*, 86 USPQ 70.

6. Claims 28, and 30-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Larson et al (US patent application publication 2004/0155653), in view of Ho et al (US patent application publication 2003/0216637).

As per claim 28, Larson et al discloses acquiring MR data to determine motion in a region of interest (Synchronizing MR images to the motion of a patient, see abstract), based on magnitude or phase differences (e.g. magnitude, phase, rate of change – may be useful for synchronizing the associated imaging data, paragraph 45), using any k-space trajectory (for example radial, spiral, or Cartesian, paragraph 37) that passes through the origin of k-space (This is preferably done by acquiring data along k-space trajectories that frequently pass through the center (or origin) of k-space, paragraph 36). Further, Larson et al implies the possibility of acquiring data at least once every repetition interval of a pulse sequence if necessary (It is not necessary that every data acquisition trajectory pass through the k-space origin, but it is preferred that this happen relatively frequently….., paragraph 38) and acquiring MR data for the central region of k-space without applying spatial encoding gradients (The timing information may be

extracted ... additional non-imaging data, paragraph 20). Larson et al does not disclose the exact timing during the repetition interval when k-space origin data are acquired for purposes of motion compensation. Larson et al discloses processing of data (processed timing data, paragraph 18), but does not explicitly disclose a computer readable storage medium.

The relative timing during the repetition time interval when k-space origin data are acquired (whether before or after further spatial encoding gradients are applied) has no bearing on its motion compensation purpose and, absent any unexpected results, is considered an obvious design choice. It would have been obvious to one of ordinary skill in the art at the time of the invention to vary the time when k-space data are acquired relative to the spatial encoding gradients because it has been held that rearranging parts of an invention involves only routine skill in the art. *In re Japikse*, 86 USPQ 70.

Ho et al discloses a computer readable storage medium for an MR scanner (paragraph 14). It would have been obvious to a person having ordinary skill in the art at the time of the invention to include a computer readable storage medium as taught by Ho et al because storage of the resulting images on a computer readable storage medium is necessary to display images at a later date and is routinely used in the MR art.

As per claim 30, the method of Larson et al, as applied to claim 28 above, is independent of the cause of motion and therefore inherently determines motion caused by respiratory and cardiac movement simultaneously. Larson does not explicitly

disclose delineating between the two causes of motion. However, the two motions occur on significantly different time scales and are therefore easily separated using filtering methods that are well known in the art.

As per claim 31, Larson et al further discloses retrospective correction of phase errors (synchronization of the data can be done retrospectively, paragraph 50).

As per claim 32, Larson et al further discloses using the motion information for retrospective or prospective gating (synchronize, paragraph 18), and respiratory-gated acquisition (Respiratory motion information can be extracted directly from the MR data and used to synchronize the image data with the quiescent period of the respiratory cycle, avoiding motion artifacts, paragraph 14).

Conclusion

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James R. Talman whose telephone number is 571-270-3029. The examiner can normally be reached on 7:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian Casler can be reached on 571-272-4956. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

James R Talman
Examiner
Art Unit 3737

Jrt

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